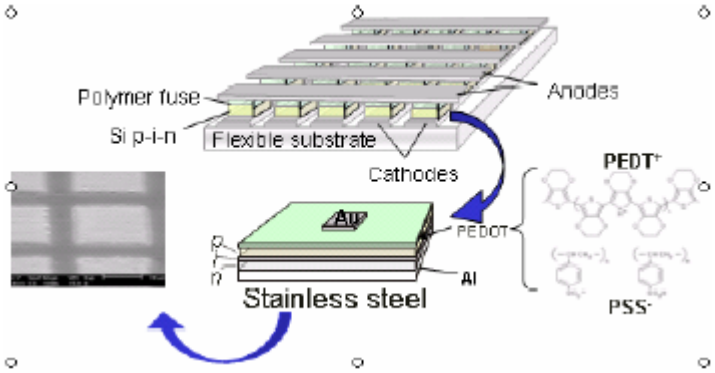
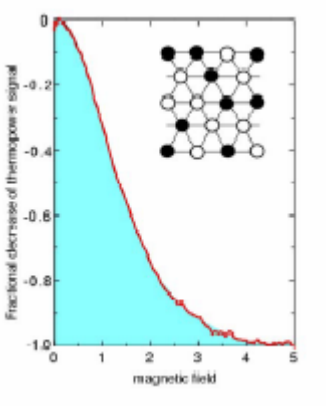
IRG 3: New Plastic Memory Technology May Replace Silicon Chips!
Steve Forrest

A new memory device developed by PCCM researchers uses thin layers of plastic film to permanently store data. Startlingly simple in design, the device could be a breakthrough that offers an inexpensive alternative to the ever-more complex memory systems based on Silicon. The new system promises more capacity and won't require a laser to read or write information from its many rows and columns. And the organic materials used are flexible and so could be shaped to fit in many spaces off-limits to the rigid Silicon.



Top: Conceptual view of a working device. Application of an electrical voltage to an individual element blows-out the small polymer fuse, creating a "0". Re-polling of the device records which columns are 1's and which are 0's. Hence a simple but effective memory is created.
Bottom: Schematic of the memory element used in this study, employing an Aluminum coated, flexible stainless steel substrate. Also shown is the chemical structural formula of the plastic polymer, PEDOT. Moller, Forrest, et al. *Nature* 426, November 2003

IRG 1: Strongly interacting electrons in NaxCoO2 - a quantum game of Go on a triangular Lattice. N. P. Ong and R. J. Cava, Princeton University, DMR-0213706



A magnetic field kills the heat-carrying capability of the electron spins as shown by the red curve. Inset depicts the Go-like hops of electrons moving in the NaxCoO2 crystal lattice.

Oxide materials exhibit many useful properties for potential applications. The cobalt oxide NaxCoO2 exhibits a large thermoelectric effect. It may find future applications in thermoelectric coolers, which are compact and vibration-free. The origin of its large thermopower has been traced to electron spins which carry a large fraction of the heat in an applied current. Surprisingly, a magnetic field can suppress this spin-heat current by 100 percent (figure). In addition, NaxCoO2 superconducts when water is added. These exotic behaviors reflect the quantum rules of how electrons hop in the material's triangular lattice, much like marbles in the popular board game Go.
Wang et al. Nature 423, 425 (2003).

Princeton University Materials Academy (PUMA).
Professor Paul Chaikin describes his experiments modeling the packing of M&Ms, and
couscous under conditions of standard temperature and pressure and in space shuttle
microgravity.PUMA students have used their summer experience to run multiple outreach
programs to teach materials science to elementary and middle students.

Above: Professor Chaikin demonstrates the use of interference patterns and diffraction in
colloid research.

Professor Rick Register works with PUMA robotics teams as they learn teamwork to conquer
engineering challenges.

Princeton Faculty and Teachers Improve Middle School Science
N.P.Ong, Robert Cava, Ravin Bhatt,

Princeton's Science Curriculum Support Project (SCSP) brings together MRSEC faculty and local lead teachers to improve commercially developed science kits in use in schools across the country.These SCSP teams publish helpful hints on PCCM's website for use by any teacher who uses the kits. The SCSP helps lead teachers better understand thescience they share with their students. Each of these teachers has over 100 middle school students in their ***class*** students per school year will directly benefit from SCSP. Thousands of teachers that use these kits nationwide can freely use our website to improve science teaching with the kits.

Above: Princeton Professor Phuan Ong works with middle school teachers to develop education products. Many teacher training sessions have been developed directly as result of the SCSP program.

Above: PCCM director Ravindra Bhatt works with teachers on SCSP curriculum. These STC middle school kits are adopted in 1000's of districts across the US.

PCCM Featured in Showcase Liberty Science Center Exhibition

Paul Chaikin, Bob Cava, Craig Arnold, Dave Srolovitz, Rick Register, Jay Benziger, Zahid Hasan, Thanos Panagiotopoulos, Doug Adamson, Daniel Steinberg, and many others at Princeton University (DMR-0213706)

Princeton Scientists Amaze Audiences with *Strange Matter*

Over 20 scientists from the NSF-funded Princeton Center for Complex Materials (PCCM) collaborate with New Jersey's Liberty Science Center on the traveling exhibit *Strange Matter*, developed by the Materials Research Society to bring materials science to the curious minds of young children and their families.

photo credit: Susan Farley

Left: Eyes wide with excitement

Right: Prof. Rick Register and graduate students demonstrate properties of polymers

In drawing among the biggest crowds ever seen at the LSC, PCCM students and faculty have inspired tens of thousands of people to think about materials science, teaching children and their parents the secrets of polymers, magnets and foams through hands-on-demonstrations and Q&A sessions.

http://www.princeton.edu/~pccm/outreach/

PCCM